IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Loucas Tsakalakos et al.	§	Group Art Unit:	1754
Serial No.: 10/722,700	§	Confirmation No.:	9948
Filed: November 25, 2003	§	Examiner:	Daniel McCracken
For: ELONGATED NANO-STRUCTURES AND RELATED DEVICES	§	Atty. Docket:	139081-1/SWA GERD:0662

Mail Stop Appeal Brief - Patents
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July 18, 2008	/Tait R. Swanson/
Date	Tait R. Swanson Reg. No. 48,226

REPLY BRIEF PURSUANT TO 37 C.F.R. § 41.41

Sir:

Appellants submit this Reply Brief in response to the Examiner's Answer mailed on May 19, 2008, pursuant to 37 C.F.R. § 41.41. Specifically, this Reply Brief addresses the Examiner's response to argument section, which begins on page 15 of the Examiner's Answer. Appellants respectfully request that the Board consider Appellants' complete arguments set forth in the previously filed Appeal Brief along with the following remarks.

After careful review of the Examiner's Answer and particularly the response to argument section beginning on page 15, Appellants stress that the Examiner's rejections do not make out a *prima facie* case of obviousness of the presently rejected claims.

Independent claim 30 and its dependent claims

Independent claim 30 recites "at least one nanorod affixed to the substrate via the conductive epitaxial buffer layer and substantially disposed within the cavity, wherein the conductive epitaxial buffer layer ***remains after formation*** of the at least one nanorod."

Appellants stress that Xu not only fails to teach a buffer layer that remains after formation of a nanorod, but Xu actually teaches away from this claim feature. Appellants reproduce several passages from Xu below:

> Some of the various methods of manufacturing the cathode devices are set forth below.
>
> Method I. FIGS. 3A-3D show cross-sectional schematic views of successive major stages of this method of fabricating a cold cathode device. FIG. 3D shows a schematic of one type of field emission cold cathode. This type of cathode can be fabricated by following steps: (1) depositing a metal catalyst film 51 on a substrate 52; (2) depositing a dielectric film 53 on the catalyst film 51, (3) depositing a gate metal film 54 on the dielectric film 53, (4) depositing photoresist 55 on the gate metal film 54 and defining a photoresist pattern 56 using photolithography, (5) etching the gate metal to produce a gate opening 57, (6) etching the dielectric to expose a portion 58 of the metal catalyst film 51, and (7) heating in an atmosphere containing a carbon source to grow carbon emitters 59 on the exposed metal film inside the gate openings. The gate metal should be selected to discourage growth of carbon fibers thereon at the emitter growth conditions.
>
> In this method, the metal catalyst film acts both as the catalyst for the carbon fiber growth and as the conductor to supply electrons to the carbon emitters if sufficiently thick. If the catalyst film is very thin it should ***break apart*** into particles upon heating and the fibers will grow directly onto the substrate surface. An advantage of this method is its simplicity; it only requires one photolithographic process.
>
> Method II. FIGS. 4A-4D shows a schematic of another field emission cathode and the major fabrication steps. The cathode has been fabricated by the following steps: (1) depositing a dielectric film 71 on a conducting or semiconducting substrate 72, or an insulating substrate

> covered with a conductive film in a patterned fashion, (2) depositing a gate metal film 73 which will form an alloy 79 with the catalyst metal during heating and which does not catalyze carbon fiber growth, (3) defining a photoresist pattern 74, (4) etching the gate metal to produce a gate opening 75, (5) etching the dielectric to expose the substrate, with an intentional undercut 76 in the dielectric, (6) depositing a metal catalyst film 77, and (7) heating in an atmosphere containing a carbon source to grow carbon emitters 78 on the exposed substrate inside of the gate openings. During heating, the metal catalyst on top of the gate metal ***dissolves*** into the gate metal and does not readily catalyze the formation of carbon fibers on the gate metal.
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> Method III. FIGS. 5A-5D shows still another processing procedure for fabricating a cathode having a structure similar to that of method II. The major process steps are: (1) depositing a dielectric film 81 on a conducting or semiconducting substrate 82, or an insulating substrate covered with a conductive film in a patterned fashion, (2) depositing a gate metal film 83, (3) defining a photoresist pattern 84, (4) etching the gate metal to produce a gate opening 85, and still keeping the photoresist pattern, (5) etching the dielectric to expose the substrate with an intentional undercut 86 in the dielectric while still keeping the photoresist on top of the gate metal, (6) depositing a metal catalyst film 87, (7) lift-off the remaining photoresist along with the catalyst film on top of the photoresist, and (8) heating in an atmosphere containing a carbon source to grow carbon-containing emitters 88 on the exposed substrate inside of the gate openings 85.
>
> The main difference between method III and method II is that method III avoids the deposition of catalyst film on the gate metal, allowing more flexibility in choosing both the catalyst and the gate metal.

Xu, col. 15, line 34 – col. 16, line 45 (emphasis added). In view of the foregoing passages, among others, Appellants emphasize that Xu teaches away from a conductive buffer layer, and more particularly a conductive epitaxial buffer layer, that remains after formation of at least one nanorod. Xu clearly teaches that the catalyst film is either removed or dissolved, such that fibers grow directly onto the substrate. *See id.*

In the Examiner's Answer, the Examiner appears to rely solely on FIG. 1 of Xu without even acknowledging the teaching away set forth above. *See* Examiner's Answer, page 16. Appellants stress that Xu must be read as a whole without merely focusing one small aspect and ignoring other contradictory aspects. In particular, Appellants stress that

FIG. 1 illustrates a catalyst metal film 14 and carbon fiber emitters 20 in a similar manner as FIG. 4D. However, the description of FIG. 1 is extremely short and fails to provide any explanation as to the methodology, stages of the process, and final form of the product. In contrast, the description of FIGS. 4A, 4B, 4C, and 4D are quite detailed and are used as the second example of a method for manufacturing the product. Like FIG. 1, FIG. 4D illustrates a metal catalyst film 77 and carbon emitters 78. However, unlike the brief description of FIG. 1, the description of FIGS. 4A, 4B, 4C, and 4D actually explains the stages of the process and the final form of the product. As reproduced above, the passages of Xu indicate that the metal catalyst film 77 dissolves during the process. *See* Xu, col. 16, lines 7-10. In other words, the catalyst film 77 does not remain after formation of the carbon emitters 78. Thus, despite the misleading illustration of FIGS. 1 and 4D, the text clearly evidences that the layers 14 and 77 are both non-existent after formation of the carbon emitters. For these reasons, among others, Appellants stress that the Examiner's focus on FIG. 1 does not account for the Xu reference as a whole, and is clearly inconsistent with the explicit teachings elsewhere in the Xu reference. As a result, Xu fails to teach or suggest (and also teaches away from) "the conductive epitaxial buffer layer remains after formation of the at least one nanorod," and thus cannot support a *prima facie* case of obviousness even in view of the secondary references.

In view of the foregoing discussion, Appellants respectfully stress that the Xu and secondary references, taken alone or in hypothetical combination, cannot support a *prima facie* case of obviousness of independent claim 30 and its dependent claims.

Independent claim 38 and its dependent claims

Independent claim 38 recites "the epitaxial conductive buffer layer ***remains after formation*** of the plurality of elongated carburized metal nanostructures."

Appellants stress that Xu not only fails to teach a buffer layer that remains after formation of a nanorod, but Xu actually teaches away from this claim feature. Appellants reproduce several passages from Xu below:

> Some of the various methods of manufacturing the cathode devices are set forth below.
>
> Method I. FIGS. 3A-3D show cross-sectional schematic views of successive major stages of this method of fabricating a cold cathode device. FIG. 3D shows a schematic of one type of field emission cold cathode. This type of cathode can be fabricated by following steps: (1) depositing a metal catalyst film 51 on a substrate 52; (2) depositing a dielectric film 53 on the catalyst film 51, (3) depositing a gate metal film 54 on the dielectric film 53, (4) depositing photoresist 55 on the gate metal film 54 and defining a photoresist pattern 56 using photolithography, (5) etching the gate metal to produce a gate opening 57, (6) etching the dielectric to expose a portion 58 of the metal catalyst film 51, and (7) heating in an atmosphere containing a carbon source to grow carbon emitters 59 on the exposed metal film inside the gate openings. The gate metal should be selected to discourage growth of carbon fibers thereon at the emitter growth conditions.
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> openings. During heating, the metal catalyst on top of the gate metal ***dissolves*** into the gate metal and does not readily catalyze the formation of carbon fibers on the gate metal.
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> Method III. FIGS. 5A-5D shows still another processing procedure for fabricating a cathode having a structure similar to that of method II. The major process steps are: (1) depositing a dielectric film 81 on a conducting or semiconducting substrate 82, or an insulating substrate covered with a conductive film in a patterned fashion, (2) depositing a gate metal film 83, (3) defining a photoresist pattern 84, (4) etching the gate metal to produce a gate opening 85, and still keeping the photoresist pattern, (5) etching the dielectric to expose the substrate with an intentional undercut 86 in the dielectric while still keeping the photoresist on top of the gate metal, (6) depositing a metal catalyst film 87, (7) lift-off the remaining photoresist along with the catalyst film on top of the photoresist, and (8) heating in an atmosphere containing a carbon source to grow carbon-containing emitters 88 on the exposed substrate inside of the gate openings 85.
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> The main difference between method III and method II is that method III avoids the deposition of catalyst film on the gate metal, allowing more flexibility in choosing both the catalyst and the gate metal.

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FIG. 4D illustrates a metal catalyst film 77 and carbon emitters 78. However, unlike the brief description of FIG. 1, the description of FIGS. 4A, 4B, 4C, and 4D actually explains the stages of the process and the final form of the product. As reproduced above, the passages of Xu indicate that the metal catalyst film 77 dissolves during the process. *See* Xu, col. 16, lines 7-10. In other words, the catalyst film 77 does not remain after formation of the carbon emitters 78. Thus, despite the misleading illustration of FIGS. 1 and 4D, the text clearly evidences that the layers 14 and 77 are both non-existent after formation of the carbon emitters. For these reasons, among others, Appellants stress that the Examiner's focus on FIG. 1 does not account for the Xu reference as a whole, and is clearly inconsistent with the explicit teachings elsewhere in the Xu reference. As a result, Xu fails to teach or suggest (and also teaches away from) "the conductive epitaxial buffer layer remains after formation of the at least one nanorod," and thus cannot support a *prima facie* case of obviousness even in view of the secondary references.

In view of the foregoing discussion, Appellants respectfully stress that the Xu and secondary references, taken alone or in hypothetical combination, cannot support a *prima facie* case of obviousness of independent claim 38 and its dependent claims.

Conclusion

In closing, Appellants remind the Board again that the Examiner bears the burden of establishing a *prima facie* case of obviousness. With that in mind, Appellants respectfully assert that the foregoing remarks, along with the previously filed Appeal Brief, clearly establish that the Examiner has failed to satisfy the proper evidentiary thresholds. Accordingly, Appellants respectfully assert that independent claims 30, 38, 44, 54, and 55 and their dependent claims are patentable over the cited references and in condition for allowance. As such, Appellants respectfully request that the Board overturn the outstanding rejections and direct the Examiner to allow these claims. If the Examiner or Board wishes to resolve any issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned attorney at the telephone number indicated below.

Respectfully submitted,

Date: July 18, 2008

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